SILAGE FOR FATTENING CATTLE.

OHIO

Agricultural Experiment Station.

WOOSTER, OHIO, U. S. A., MAY, 1908.

BULLETIN 193.

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BULLETIN

OF THE

Ohio Agricultural Experiment Station

NUMBER 193. MAY, 1908.

SILAGE FOR FATTENING CATTLE.

BY B. E. CARMICHAEL.

In these days of high-priced land and feed and of close margins in cattle feeding operations, it is, among other equally important considerations, essential that a careful selection of feeds be made if the best possible results are to be secured from the feeding of cattle for beef.

Cattle feeders depend chiefly upon the corn crop for feed for fattening cattle and it is very important that an economical use be made of this crop. The excellent results obtained from the use of corn silage for dairy cows (Bulletin 155 of this Station) have suggested the possibility of its being valuable for fattening beef cattle, and quite a number of cattle feeders have reported good results from its use. There are not, however, many definite data at hand concerning the real value of corn silage for fattening cattle. The need for exact information on this point has suggested the importance of conducting experiments to determine whether or not silage should be given a place in beef-cattle feeding operations, and if so, how extensively it should be used. The experiment which is reported in detail in this bulletin was begun in February, 1907. An experiment now in progress and similar in all essentials to the one conducted in 1907 was begun in January, 1908.

While the results of the first of these experiments indicate that silage may be used with profit, a single experiment will not justify any very far reaching conclusions. The results of the first test are, therefore, given to cattle feeders with the express statement that further work along this line is needed before conclusive evidence can be obtained. Sufficient evidence is at hand, however, to justify the assertion that silage may, under some conditions, give very satisfactory results when used for fattening cattle.

CATTLE USED IN THE EXPERIMENT.

The animals purchased for use in this experiment consisted of 42 head of steers, most of them grade Shorthorns, selected on the Chicago market for the Station by a Chicago commission firm. The steers were very thin when they were put on feed, but were in no way stunted or unthrifty. As a lot, these cattle were rugged feeders, not of the very highest grade, but, nevertheless, a good kind of steers—such as may be purchased at almost any time on the Chicago market.

The cattle were purchased in Chicago on January 29, 1907, and arrived at Wooster the following day. All of them were fed the same kind of feeds, consisting chiefly of shelled corn, corn stover and alfalfa, mixed clover and timothy, and soybean hay, until February 21, when they were divided into lots for experimental feeding.

PLAN OF THE EXPERIMENT.

The steers were divided into six lots of seven* steers each. The lots were numbered from 1 to 6, inclusive. Lots 1, 3 and 5 received a ration consisting in part of corn silage, while Lots 2, 4 and 6 received dry feed exclusively. The lots which were fed silage received, after they had become accustomed to it, 25 pounds of silage per head daily, in two equal feeds. On account of the grain which was present in the silage, Lots 2, 4 and 6 (fed the dry ration) were fed more shelled corn than Lots 1, 3 and 5 received. Cottonseed meal was fed regularly to all lots in the same amounts, beginning with one-half pound daily per steer. When alfalfa, clover and soy-bean hay were fed a smaller amount of cottonseed meal was given than when mixed (clover and timothy) hay was fed. The highest amount of cottonseed meal fed was 2.5 pounds daily per steer. All lots received stover and hay of various kinds, but the silage-fed lots consumed much less of these feeds than did the dry-fed lots. Shelled corn was fed.

Hogs were put with each lot of cattle. The plan was to have a sufficient number of hogs in each pen to consume all of the grain that appeared in the steers' droppings. However, throughout the experiment a small amount of corn was left by the hogs in all of the lots. At the beginning of the test two hogs were put with each lot of steers, later another hog was added to each lot. On May 22 the first set of hogs was sold and four thin hogs were put with each lot of steers.

*Soon after the experiment began, one steer in lot 5 died. The calculations necessary to eliminate this steer from the test have been made. Lot 5, then, contained only 6 steers.

Each lot of cattle and the hogs which followed them occupied a small pen, having about 320 to 345 square feet of floor space, feed racks included. Although these quarters were very small, yet the cattle seemed to suffer no special inconvenience from the close confinement. For a part of the time the hogs were allowed access to small lots outside of the barn. It seems very probable that fattening cattle do not need so much room as is afforded by many corn belt feed lots.

Salt was kept constantly before the steers, common barrel salt being used. Care was taken to avoid allowing the steers access to a large amount of salt while they were very "salt hungry." Small amounts were given until the steers did not show a very great desire for it, after which a generous supply was placed where they could have free access to it.

Water was supplied to the steers in small galvanized iron tanks, one in each pen. These small tanks were filled from a larger storage tank in the barn.

Refuse hay and stover, consisting of the impurities and very coarse parts of these feeds, together with wheat and oat straw were used for bedding. The pens were kept in good condition at all times, but no excessive amount of bedding was supplied.

The hay that was fed consisted of various kinds, grown on the Station farm. When any given kind was used, it was used for all of the lots, that is, when clover hay was being fed, all six lots of the steers received clover hay. The corn stover was grown on the farm and was cut to short lengths before being fed. When cut it was much more convenient to handle and the refuse was more useful for bedding than it would have been if the stover had been fed whole. The corn silage had been in the silo for more than a year, having been put in during the fall of 1905. It was made from a large variety of silage corn, rather than from the local smaller-growing, heavy-earing varieties. The cottonseed meal was purchased from a Memphis, Tennessee, firm. It was the so-called "extra prime" meal.

In all cases where the amount of feed used is under consideration the amount actually consumed is given. In the case of the corn stover there is a wide difference between the amount offered and that actually eaten by the steers; in general about one-third would be left. It was planned to feed such amounts as would be eaten fairly closely, without requiring the coarse stalks to be eaten. It should be borne in mind, then, that the amount of feed actually consumed is the amount that is given. The silage was practically all eaten, while with the hay the very coarse parts of the stems and weeds were left. It was planned to feed all the roughage that the steers would eat, throughout the entire experiment.

The cattle were fed twice daily, one-half of the ration being given in the morning, and one-half at night. A small amount (one-half pound to one and three-fourths pound daily per steer) of chaffed hay was mixed with the grain for the dry-fed lots. The grain for the silage-fed lots was put on the silage.

Individual weights of the steers were taken February 19, 20 and 21, but the experiment did not begin until February 27, after the steers had become somewhat accustomed to their new rations.

When the experiment began, on February 27, the following amounts of feed were used by the two different sets of steers:

	Silage-fed Lbs.	Dry-fed Lbs.
Corn	7.0	7.0
Cottonseed meal	0.5	0.5
Silage	12.0	
Stover	4.5	7.6
Hay	7.0	7.3

The silage was gradually increased until the lots which received silage were fed at the rate of 25 pounds of silage daily per steer. When on "full feed" the dry-fed lots received 20 pounds shelled corn and 2.5 pounds cottonseed meal, and the silage-fed lots received 17 pounds corn and 2.5 pounds cottonseed meal daily per steer, all lots receiving all of the dry roughage they would eat. As long as the stover lasted, all lots received one feed per day of stover and one feed of hay. After the stover had been entirely used, hay was the only dry roughage fed. The hay was of various kinds, as is indicated in Table V.

TABLE I—Specimen rations—pounds of feed consumed daily per steer.

Date	Silage-fed lots—1, 3 and 5.					Dry-fed Lots—2, 4 and 6			
	Corn	Cotton-seed meal	Silage	Stover	Hay	Corn	Cotton-seed meal	Stover	Hay
Feb. 27	7	0.5	12	4.5	7.0	7	0.5	7.6	7.3
March 16	12	1.0	25	2.5	3 1	15	1.0	4.8	7.7
March 31	14	1 0	25	2.3	3.3	17	1.0	4 5	7.2
April 30	14	1 5	25	....	6.7	17	1.5	....	14 3
May 31	17	2 5	25	....	4.6	20	2.5	....	13.4
July 15	17	2 5	25	....	5 3	20	2.5	....	13.7

It is believed that the specimen rations for the different dates mentioned in Table I, will give the reader a better idea of the changes that were made in the rations at various stages of the experiment than would a table showing average rations for 3 or 4-week periods throughout the experiment. The changes in amount of feed were made very gradually to prevent any of the troubles that are so likely to occur when too sudden changes in amount of feed are made. Slight variations in the amount of feed were made from time to time, as a few of the steers were off feed slightly on several different occasions. These irregularities were rather infrequent, however.

The specimen rations for the various dates represent the amount of feed actually consumed by the steers. All feed refused by the steers was weighed and deducted from the total amount fed, only the amount which they ate being charged to them.

TABLE II—Individual weights and gains of steers.

Steer No.	Average for Feb. 19-20-21	Average for July 16-17-18	Gain 147 days	Steer No.	Average for Feb. 19-20-21	Average for July 16-17-18	Gain 147 days
SILAGE-FED				DRY-FED			
Lot 1.				Lot 2.			
	Lbs.	Lbs.	Lbs.		Lbs.	Lbs.	Lbs.
1	956⅔	1,405	448⅓	8	966⅔	1.339	372⅓
2	950	1,245⅔	295⅔	10	1,008⅓	1,246⅔	238⅓
3	831⅔	1,180	348⅓	11	956⅔	1,295	338⅓
4	841⅔	1,107⅓	265⅔	12	1,035	1,402⅓	367⅓
6	1,023⅓	1,408⅓	385	13	890	1,230	340
7	923⅓	1,290	366⅔	14	826⅔	1,130	303⅓
40	886⅔	1,280	393⅓	23	868⅓	1,228⅓	360
Total	6,413	8,916⅓	2,503	Total	6,551⅓	8,871⅓	2,319⅔
Av'ge	916.19	1,273.76	357.57	Av'ge	935.95	1,267 33	331.38
Lot 3.				Lot 4.			
15	933⅓	1,213⅓	280	22	961⅔	1,295	333⅓
16	1,026⅔	1.259	232⅓	24	920	1,274	354
18	985	1,511⅔	526⅔	25	923⅓	1,274⅓	351
20	910	1,206⅔	296⅔	26	948⅓	1,281⅔	333⅓
21	963⅓	1,340⅔	377⅓	27	983⅓	1,456⅔	473⅓
29	820	1,130	310	28	850	1,184	334
41	886⅔	1,217⅔	331	9	911⅔	1,273⅓	361⅔
Total	6,525	8,879	2,354	Total	6,498⅓	9.039	2,540⅔
Av'ge	932 14	1,268 43	336.29	Av'ge	928.33	1,291.29	362.95
Lot 5.				Lot 6.			
17	1,080	1.476	396	36	866⅔	1,115	248⅓
30	920⅔	1,391⅔	471	37	973⅓	1,326⅔	353⅓
...	.....	....	.....	38	1,056⅔	1.405⅔	349⅓
32	928⅓	1,261⅔	333⅓	39	896⅔	1,295	398⅓
33	858⅓	1,245	386⅔	42	781⅔	1,135	353⅓
34	1,030	1.375	345	5	938⅓	1,201⅔	263⅓
35	910	1,241⅔	331⅔	19	963⅓	1,330	366⅔
Total	5.727⅓	7,991	2.263⅔	Total	6,476⅔	8,809	2,332⅓
Av'ge	954.56	1331.83	377.28	Av'ge	925.24	1,258.43	333.19

As was previously stated, individual weights of all the steers were taken February 19, 20 and 21, one week before the experiment began. At the conclusion of the experiment individual weights were again secured, being taken on July 16, 17 and 18. The weights thus taken are of interest in showing the great variation in gain produced by different steers even when fed under the same conditions and upon the same rations. The weights of the individual steers, as given in Table II, were taken previous to the beginning of the experiment, and each lot was weighed on three successive days one week later, February 26, 27 and 28, at which time the experiment began.

TABLE III—Weekly weights and gains of steers.

Date	Lot 1—7 steers		Lot 2—7 steers		Lot 3—7 steers		Lot 4—7 steers		Lot 5—6 steers		Lot 6—7 steers	
	Wt.	Gain	Wt.	Gain	Wt.	Gain	Wt.	Gain	Wt.	Gain	Wt.	Gain
	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.	Lbs.
Feb. 26-27-28	6,612	....	6,658	....	6,743	....	6,637	...	5,900	....	6,623	....
March 6	6,765	153	6,810	152	6,955	212	6,780	143	6,055	155	6,700	77
" 13	6,855	90	6,925	115	7,045	90	6,885	105	6,155	100	6,880	180
" 20	6,895	40	7,110	185	7,125	80	6,975	90	6,310	155	6,980	100
" 27	6,920	25	7,050	60	7,130	5	7,005	30	6,335	25	7,000	20
April 3	7,160	240	7,225	175	7,520	190	7,210	205	6,525	190	7,190	190
" 10	7,290	130	7,340	115	7,460	140	7,355	145	6,595	70	7,405	215
" 17	7,450	160	7,465	125	7,485	25	7,450	95	6,650	55	7,425	20
" 24	7,465	15	7,490	25	7,690	205	7,595	145	6,825	175	7,425	....
May 1	7,615	150	7,605	115	7,690	....	7,640	45	6,845	20	7,510	85
" 8	7,785	170	7,730	125	7,810	120	7,910	270	6,965	120	7,695	185
" 15	7,900	115	7,825	95	7,845	35	7,910	....	7,020	55	7,825	130
" 22	8,120	220	8,080	255	8,105	260	8,140	230	7,245	225	8,055	230
" 29	8,290	170	8,170	90	8,155	50	8,240	100	7,370	125	8,105	50
June 5	8,345	55	8,360	190	8,320	165	8,420	180	7,470	100	8,210	105
" 12	8,480	135	8,375	15	8,405	85	8,525	105	7,520	50	8,295	85
" 19	8,570	90	8,515	140	8,495	90	8,690	165	7,625	105	8,525	230
" 26	8,610	40	8,590	75	8,500	5	8,725	35	7,655	30	8,555	30
July 3	8,645	35	8,700	110	8,605	105	8,810	85	7,785	130	8,670	115
" 10	8,760	115	8 835	135	8,730	125	8,950	140	7,875	90	8,745	75
" 16-17-18	8,916	156	8,871	36	8,879	149	9,039	89	7,991	116	8,809	64
Total gain, 140 days	....	2,304	....	2,213	....	2,136	....	2,402	....	2,091	....	2,186

Table III shows the initial weight of each lot, the weight each week and the final weight, together with the weekly and total gains. Some very wide fluctuations in weight will be observed. These variations are not easy to account for; in fact, no satisfactory explanation is at hand. The three-days' initial and final weights were taken for the purpose of eliminating these variations so far as possible.

TABLE IV—Summary of weights and gains.

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Initial weight, Feb. 27.....	6,612	6,658	6,743	6,637	5,900	6,623
Final weight, July 17	8,916	8,871	8,879	9,039	7,991	8,809
Gains, 140 days...	2,304	2,213	2,136	2,402	2,091	2,186
Average gain per head.....	329.14	316.14	305.14	343.14	348.5	312.29
Average daily gain.	2.351	2.258	2.180	2.451	2.489	2.231

A summary of the weights and gains for each of the lots is given in Table IV. It will be seen that the average daily gain per steer ranged from 2.18 pounds with Lot 3 to 2.49 pounds with Lot 5.

TABLE V—Pounds feed consumed by steers, Feb. 27-July 16, 1907.

Lot No.	Corn	Cotton-seed meal	Chaffed hay	Silage	Stover	Bean hay	Alfalfa hay	Clover hay	Mixed hay
SILAGE-FED LOTS—20 STEERS.									
1	14,543.5	1,694.75	64.75	23,693	771.50	150.0	150.0	1,888.00	2,403.75
3	14,642.0	1,691.25	64.75	23,918	847.50	153.5	178.5	2,050.25	2,479.25
5	12,598.5	1,453.75	55.75	20,535	577.64	125.57	154.0	1,673.00	2,430.25
Total	41,784.0	4,839.75	185.25	68.146	2 196.64	429 07	482.5	5.611.25	7.313.25
DRY-FED LOTS—21 STEERS.									
2	17,486.0	1.695.75	1,128.0	....	1,465.50	157.5	181.5	3,287.50	5,416.50
4	17,486.0	1,695.75	1,128.0	....	1,630.75	160.0	180.5	3,463.00	5,551.00
6	17,335.0	1,682.25	1,119.6	....	1,809.75	183.5	180.5	4,048.00	6,684.75
Total	52,307.0	5.073.75	3,375.6	....	4.906.00	501.0	542.5	10,798.50	17,652.25

Tables VI and VII, giving the amount and cost of feed required by each lot of steers to produce 100 pounds gain, show that there was quite a marked variation, even with lots that were fed the same. In only one instance did any of the dry-fed lots make as cheap gains as did the silage-fed lots. Lot 4, dry-fed, made slightly cheaper gains than did Lot 3, silage-fed. However, Lot 4 made gains much cheaper than did either Lot 2 or Lot 6, and Lot 3 made more expensive gains than did either Lot 1 or Lot 5. It must be understood that Table VII applies only to the market prices that are given.

TABLE VI—Pounds feed consumed by steers per 100 pounds gain.

Lot	Concentrates	Silage	Stover	Hay
SILAGE-FED LOTS.				
1	704.785	1,028.346	33.485	202.105
3	764.665	1,119.757	36.677	230.630
5	672.035	982.066	27.625	212 270
DRY-FED LOTS.				
2	866.776	....	66.222	459.602
4	798.574	....	67.891	436.407
6	869.957	....	82.788	558.845

TABLE VII—Cost of feed consumed by steers per 100 pounds gain.

	Silage-fed			Dry-fed		
	Lot 1	Lot 3	Lot 5	Lot 2	Lot 4	Lot 6
Corn @ 45 cents per bushel....	$5.07	$5.51	$4.84	$6.35	$5.85	$6.37
Cottonseed meal @ $26.50 per ton	.97	1.05	.92	1.02	.94	1.02
Stover @ $4 per ton.....	.07	.08	.06	.13	.14	.17
Silage @ $3 per ton.....	1.54	1.68	1.47	.....	.....	.....
Hay @ $12 per ton.....	1.21	1 38	1.27	2.76	2.62	3.35
Total.....	8.86	9.70	8.56	10 26	9.55	10 91

TABLE VIII—Feed consumed, gains produced and cost of gains.

	Silage-fed—Lots 1, 3 and 5 20 head		Dry-fed—Lots 2, 4 and 6 21 head.	
	Amount	Value	Amount	Value
Corn @ 45 cents per bushel.....	746.143 bus.	$335.764	934.054 bus.	$420.324
Cottonseed meal @ $26.50 per ton.....	2.420 tons	64.100	2.537 tons	67.231
Silage @ $3.00 per ton.....	34.073 tons	102.219	.....	.....
Stover @ $4.00 per ton.....	1.098 ton	4.392	2.453 tons	9.812
Hay @ $12.00 per ton.....	7.011 tons	84.132	16.435 tons	197.220
Total cost of feed consumed.....		$590.637	.....	$694.587
Gains produced.....	6,531 lbs.		6,801 lbs.	
Average daily gain per steer.....	2.333 "		2.313 "	
Cost per 100 lbs. gain.....		$9.04	....	$10.21

Table VIII shows the total gains and average daily gain per steer made by the three lots fed silage and by the three lots that were dry-fed, together with the total cost of feed consumed by the two sets of three lots each, and the cost of 100 pounds gain in live weight. The average daily gain per steer was almost exactly the same for both of the sets, so there is no apparent difference between the two rations so far as rate of gain is concerned. But *rate* of gain is only one of the profit deciding factors. The costs of gains, on the basis of the prevailing market prices of feed, are quite widely apart. This cost of gains, it must be understood, is based upon an uncertainly varying factor—market prices for feeds.

REPLACEMENT VALUE OF CORN SILAGE.

To put the whole matter upon a more definite basis, the replacement value of a ton of silage for beef production has been computed. This table takes into consideration the lower pork production when silage is used. It was found that under the conditions of this experiment, one ton of silage was equivalent to, or replaced 4.4266 bushels of corn, .0369 tons of corn stover and .257 ton of mixed hay, so far as gains by the cattle are concerned. Since both sets of steers received the same amounts of cottonseed meal daily per steer and made approximately the same gains, the cottonseed meal replaced is so small an amount—less than one pound—that it is not taken into consideration. Using these figures, we may determine the value of a ton of corn silage as shown in this test, for any market conditions. For the purpose of showing the need for considering various market conditions Table IX has been prepared. Even if the lowest of the assumed prices had prevailed, it is seen that corn silage would have proved a very valuable feed. With the highest assumed prices the replacement value of the corn silage is found to be $4.63 per ton.

TABLE IX—Replacement value of silage.

Corn per bushel	$ .30	$ .40	$ .50
Stover per ton	3 00	4.00	5.00
Hay per ton	6 00	8.00	10 00
1 ton silage for beef production = 4.4266 bushels corn	$1.33	$1.77	$2.21
.0369 ton stover	.11	.15	.18
.2574 ton hay	1 54	2 06	2.57
	$2 98	$3.98	$4.96
6 6 pounds less pork produced per ton silage, @ 5 cts. per pound.	.33	.33	.33
Net replacement value of silage per ton	$2.65	$3.65	$4.63

Aside from the replacement value of corn silage, there are various considerations that should be taken into account when we decide whether or not to use silage. (*a*) Harvesting silage is heavy work and comes at a season of the year when there is other work on hand. (*b*) Special machinery is required to make silage. (*c*) Silage should be fed in a place that does not freeze very readily. (*d*) There is considerable danger of silage spoiling in the silo when fed very slowly, especially during warm weather. The common rule is: Feed at least an inch in depth from the silo each day in winter, two inches in summer. This rule cannot be said to be exactly applicable to all cases, but is probably not far wrong for Ohio conditions.

Some of the advantages of the use of silage are: (*a*) Practically all of the corn crop is utilized. (*b*) The field is in good condition for fall cultivation after the corn has been removed. (*c*) The silo affords very economical storage. (*d*) If proper arrangements are made, silage is a most convenient feed to handle. (*e*) If well stored, silage does not deteriorate in palatability as does corn stover late in the spring. (*f*) Less loss results in seasons which do not favor a complete maturing of the crop, as corn may be used for silage to good advantage even if not thoroughly matured.

After all these points have been taken into consideration, the feeder will need to apply them to his own special conditions before he can say definitely that the silo is or is not valuable for his use.

HOGS.

The data concerning the hogs used in this test are presented in Table X. Not all of the gains made by the hogs can be credited to corn in the droppings from the steers, as some of the lots received a small amount of tankage. However, the lots that followed the dry-fed steers and those that followed the silage-fed steers received equal amounts of tankage, so the use of this supplement does not in any way interfere with a comparison of the two lots. Throughout the test, a very small amount of corn was left in all of the pens. It should be stated that no grain was fed to the hogs, but they depended solely upon the grain which appeared in the droppings, excepting the small amount of tankage that was fed to some of the lots.

It is entirely reasonable to expect to secure somewhat smaller gains from hogs following silage-fed cattle than from those which follow cattle fed wholly upon dry grain—providing, of course, the silage-fed steers receive a smaller allowance of dry grain than is given the dry-fed lots. The grain that is derived from the silage is in a softer condition and it would be expected to be more thoroughly masticated and digested by the steers than would the dry, hard corn.

TABLE X—Pork production.

	With silage-fed steers			With dry-fed steers		
	Lot 1	Lot 3	Lot 5	Lot 2	Lot 4	Lot 6
FIRST SET. (2 pigs in each lot until March 6; 3 pigs in each lot after March 6)						
Initial weight, Feb. 27	178	188	193	188	191	211
" " Mar. 6	75	65	70	75	67	67
Total initial weight	253	253	263	263	258	278
Final weight, May 22	565	493	435	495	530	655
Gains	312	181*	231*	232	272	377
Average daily gain per pig	†1.273	.739	.943	.947	1.11	†1.539
Total gain			724			881
Average daily gain per pig			.985			1.199
SECOND SET (4 pigs in each lot)						
Initial weight, May 22	445	460	430	450	470	445
Final weight, July 17	766	657	633	707	692	755
Gains	321	197	203	257	222	310
Average daily gain per pig	†1.433	.879	.906	1.147	.991	†1 384
Total gain			721			789
Average daily gain per pig			1.073			1.174
Total gain (both sets)			1,445			1670
Average daily gain per pig (both sets)			1.027			1.187

*Pig in Lot 3 weighing 91 pounds exchanged for pig in Lot 5 weighing 150 pounds.
†Lots 1 and 6 received tankage, ½ pound daily per pig. Note the increased gains.

The use of tankage for hogs was found to be very beneficial, as the lots which received it made much greater gains than were made by the lots that did not receive it. For a discussion of the details of the experiment with tankage for hogs, conducted in conjunction with this experiment, the reader is referred to Circular 73, of this Station, which may be had upon request.

SHIPPING AND SALE.

As was previously stated, the cattle were shipped July 20. The silage-fed lots received their usual allowance of all feeds (including silage) on the morning of July 19. The night feed for these lots was made up of ⅔ of the regular feed of grain and silage together with all the hay they would eat. No silage was fed July 20. The night grain feed on July 19 for the dry-fed lots was only ⅔ as much as was usually given. The regular morning allowance of grain was given all lots July 20, and all lots had free access to hay before leaving the barn.

TABLE XI—Shrinkage in shipping

	Home weight July 20	Pittsburg wt. July 22	Shrinkage	Percent Shrinkage
Silage-fed	26,100	25,180	920	3 52
Dry-fed	27,765	26,400	1,365	4 91
	Av'ge weight July 16-17-18		Shrinkage on basis of 3-days' weight at close of test.	Percent shrinkage on basis of 3 days' weight at close of test.
Silage-fed	25,786	25,180	606	2 35
Dry-fed	26,719	26,400	319	1 19

Table XI shows the average of the 3 final weights taken at the close of the experiment, the weights secured in the forenoon of July 20 after the cattle had been given feed and water, and the Pittsburg weights of each of the lots. It will be observed that the shrinkage from shipping, on the basis of home weights after feed and water had been given on July 20, was really less for the silage-fed lots than for the dry-fed lots. However, when the average of the three weights taken at the close of the experiment is taken into consideration a heavier shrinkage resulted with the silage-fed lots than with dry-fed lots. There are so many unusual conditions surrounding the cattle during shipment and at the yards that it is not possible to say definitely from the results of a single test that the use of silage did or did not cause a greater shrinkage than would result from dry feeding. Additional data on this point are needed before any definite conclusions may be drawn.

When sold in Pittsburg the cattle were sorted according to condition. Three steers from the dry-fed lots and five from the silage-fed lots were sold at $5.60 per hundredweight, while the others sold at $6.60. The 8 steers that sold at $5.60 lacked finish to a marked degree. It is not believed that the feeding of silage was responsible for the fact that 5 steers from the silage-fed lots were sold at $5.60 while only 3 from the dry-fed lots had to be sold at this reduction of $1.00 per hundredweight, since it is a common occurrence for a few steers to "feed out" poorer than the others. It should be stated here that the 15 silage-fed steers that sold at $6.60 occupied one pen at the stock yards, while the 18 dry-fed steers that sold at the same price were in a separate pen. No difference in the finish of these two pens of cattle could be noticed by the buyer, the commission salesman or other expert cattlemen who saw them. Since both lots were fed, in the aggregate, about the same amount of grain daily, and since the silage was used more largely for roughage than as a grain substitute, no marked difference in finish would be expected. If silage had been fed in very large amounts with a small grain allowance it seems very probable that a difference due to feed would have been noticed at the time of marketing.

MANURE PRODUCTION.

When taken from the pens the manure was weighed in order to obtain records of the amount of manure produced by the steers. The data relating to manure production are presented in Tables XII and XIII. It should be stated that the manure was made under cover, without being exposed to rains. The amount of excrement recovered under average corn-belt feed lot conditions would doubtless be much smaller than that obtained in this experiment.

TABLE XII—Manure production.

	Silage-fed steers*	Dry-fed steers†
Total manure produced	182,355 lbs.	215,770 lbs.
Less floats used	3,031 "	3,171 "
Excrement and bedding	179,324 "	212,599 "
Less bedding used	28,509.5 "	29,979 "
Total excrement	150,814.5 "	182,620 lbs.
Daily excrement per steer	49.93 "	57.78 "

*21 steers for 10½ days; 20 steers 140 days.
†21 steers 150½ days.

Ground rock phosphate, known as floats, was applied to the manure in each pen at the rate of one pound daily per steer. Bedding, consisting of straw, refuse stover and refuse hay, was used: an average of 9.44 pounds daily per steer for the silage-fed lots, and 9.49 pounds daily per steer for the dry-fed lots. Deducting the bedding and the ground rock phosphate from the total manure produced daily per steer, it is found that the average daily amount of excrement per steer recovered from the silage-fed lots was 49.93 pounds, and from the dry-fed lots 57.78 pounds.

TABLE XIII—Feed consumed and bedding used per ton of manure (exclusive of floats) produced.

	Silage-fed steers	Dry-fed steers
Concentrates	545.9 lbs.	564.0 lbs.
Dry roughage	202.8 "	382.0 "
Silage	786.5 "	.....
Bedding	318.0 "	282.0 "

In these figures no account has been taken of the hogs that were kept with the steers. No feed other than a small amount of tankage was given to the hogs, but, on account of the water in their excrement the total manure production is doubtless somewhat larger than it would have been if no hogs had been kept with the steers.

For information concerning the production, composition and use of farm manure, the reader is referred to Bulletin 183, of this Station, which will be mailed upon request.

FINANCIAL STATEMENT.

Although a statement of the financial outcome of a feeding experiment has only a very limited value, it is given here to show the "dollars and cents" side of the experiment. The reader is cautioned to note with care the market conditions to which this statement applies. Twenty-six of the steers were purchased at $4.30 per hundred pounds, the other 16 cost $4.15 per hundred pounds, Chicago weight. The Chicago purchase price, commission, shipping expenses and value of feed consumed brought the cost of the 42 steers, on February 20, to $4.74 per hundred pounds.

The feeds consumed during the experiment are charged at the market prices which prevailed for these feeds. The hogs are figured at 50 cents less per hundred pounds than the Pittsburg quotations for hogs of the same weight on the dates given in the financial statement.

Under different market conditions different financial results would have been obtained. Tables VI, IX and XV, showing the amount of feed consumed by the various lots for 100 pounds gain, the effect of varying market prices for feeds other than silage upon the replacement value of silage and the margins between the cost of feeder cattle and the selling price necessary to prevent loss under varying market conditions, are worthy of much more attention than is the financial statement, which, as previously stated, applies only to the market conditions which prevailed during the experiment.

In the financial statement no account is taken of the fact that one steer in Lot 5, fed silage, died early in the experiment. There was no evidence to indicate that the feeding of silage was responsible for the loss of this steer. At the time of taking the first individual weights this steer weighed 838 pounds. Figuring his value at $4.74 per hundredweight and assuming that he ate one-seventh of the feed given to Lot 5 while he was with this lot, the loss resulting from his death was $40.93.

The cost of feeding crops to cattle should be little, if any, higher than the cost of hauling the same crops to market. This will, of course, depend very largely upon local conditions. If the same net price can be realized for the crops when fed to live stock as when hauled to market, the feeding operation must be considered a success, since most of the fertilizing constituents of the crops are retained to help maintain and increase the producing capacity of the farm.

Almost all, if not all, neighborhoods will show good examples of farms from which crops have been persistently sold, year after year, decade after decade, and other farms upon which the product has

practically all been intelligently fed to live stock and the manure carefully returned to the fields. The first described system cannot properly be called farming, but rather belongs to the same class of resource-consuming operations as does mining and lumbering, and does not tend in any respect to a permanency in farming. Whether or not the fattening of beef cattle is the wisest method of feeding farm crops must be determined by the farmer himself after taking into consideration the various conditions which surround him. However, the keeping of some kind of live stock is almost absolutely necessary if the producing capacity of farm lands is to be most economically maintained.

TABLE XIV—Financial statement.

SILAGE-FED STEERS.

		Dr.		
Feb. 20	20 steers, 18,666 lbs.	@ $4 74 per cwt.	$884.77	
	782.45 bushels corn	@ .45 " bu.	352.10	
	2.528 tons cottonseed meal	@ 26.50 " ton	66.99	
	35.2115 tons silage	@ 3.00 " "	105.63	
	1.452 ton stover	@ 4.00 " "	5.81	
	7.5877 tons hay	@ 12.00 " "	91.05	
July 20	Shipping expenses		58.86	
Feb. 21	6 pigs, 541 lbs.	@ 6.50 per cwt.	35.17	
Mar. 6	3 pigs, 210 "	@ 6.50 " "	13.65	
May 22	12 pigs, 1,335 lbs.	@ 6.40 " "	85.44	
	153.75 lbs. tankage	@ 40 00 " ton	3.08	
	Total expenditures			$1,702.55
		Cr.		
July 20	15 steers, 19,450 lbs.	@ $6.60 per cwt.	$1,283.70	
	5 steers, 5,730 lbs.	@ 5.60 " "	320.88	
May 22	9 pigs, 1,493 lbs.	@ 6.25 " "	93.31	
July 20	12 pigs, 2,101 lbs.	@ 5.90 " "	123.96	
	Total receipts			1,821.85
	Profit			119.30
	Profit per steer			5.97

DRY-FED STEERS

		Dr.		
Feb. 20	21 steers, 19,527 lbs.	@ $ 4.74 per cwt.	$925.58	
	975.93 bushels corn	@ .45 " bu	439.17	
	2.65 tons cottonseed meal	@ 26.50 " ton	70.23	
	2.915 tons stover	@ 4.00 " "	11.66	
	17.39 tons hay	@ 12.00 " "	208.68	
July 20	Shipping expenses		61.72	
Feb. 21	6 pigs, 570 lbs.	@ 6.50 per cwt.	37 05	
Mar. 6	3 pigs, 209 lbs.	@ 6.50 " "	13.59	
May 22	12 pigs, 1,365 lbs.	@ 6.40 " "	87.36	
	153.75 lbs. tankage	@ 40.00 " ton	3.08	
	Total expenditures			$1,858.12
		Cr.		
July 20	18 steers, 22,850 lbs.	@ $ 6.60 per cwt.	$1,508.10	
	3 steers, 3,550 lbs.	@ 5.60 " "	198.80	
May 22	9 pigs, 1,680 lbs.	@ 6.25 " "	105.00	
July 20	12 pigs, 2,203 lbs.	@ 5.90 " "	129.98	
	Total receipts			$1,941.88
	Profit			83.76
	Profit per steer			3.99

Table XV is intended to show the margin between home cost and home selling price required, under various market conditions, for feeder cattle and feeds, in order to prevent loss. The feeds actually consumed and the gains actually secured by the two sets of steers (dry-fed and silage-fed) are used as the basis for the calculations. The pork produced by each set is valued at 5 cents per pound and tankage is charged to each set at the rate of $40 per ton.

TABLE XV—Varying market conditions.

Feeds	Prices for feeds.		
Corn	30 cents per bu.	40 cents per bu.	50 cents per bu.
Cottonseed meal	$21.00 per ton	$28.00 per ton	$35.00 per ton
Silage	2.25 " "	3.00 " "	3.75 " "
Stover	3.00 " "	4 00 " "	5.00 " "
Hay	6 00 " "	8.00 " "	10 00 " "

Home cost per cwt. for feeder cattle	Price for which fat steers would have had to sell per hundredweight *at home* to prevent loss, with feeds and feeder cattle at given prices.					
	Silage-fed	Dry-fed	Silage-fed	Dry-fed	Silage-fed	Dry-fed
$3.50	3.88	3.95	4.40	4.50	4.91	5.05
3.75	4.07	4.14	4.58	4 69	5.10	5.24
4.00	4.26	4.33	4.77	4.87	5.28	5.42
4.25	4.44	4.51	4.96	5 06	5.47	5.61
4.50	4.63	4.70	5.14	5.25	5.66	5.79
4.75	4.82	4.88	5.33	5 43	5.84	5.98
5.00	5.00	5 07	5 52	5.62	6.03	6.17

It will be observed that, other things being equal, a greater margin is required to prevent loss with low-priced feeders than with feeders at high prices. High-priced feeds necessitate a greater margin than do cheap feeds. The margin required under all conditions represented in the table, is less for the silage-fed lots than for the dry-fed lots. This difference when feeds are cheap is very slight, however. With the highest-priced feeds mentioned the difference is 14 cents per hundredweight. In using the figures presented in this table, all market conditions that are assumed should be taken into consideration, as changes in these would change the margin required to prevent loss. It is an easy matter to apply any market conditions to the results obtained in this experiment. Tables IV and X give initial and final weights and total gains for cattle and hogs, and Table VI gives the amount of food required per hundred pounds gain by the cattle. The amount of tankage con-

sumed during the experiment was the same for the hogs following the silage-fed cattle and for those that followed the dry-fed cattle—149.75 pounds. The results that would be obtained under any special market conditions can be calculated from the data referred to, and should be of much more real service to feeders than the financial statement, which applies only to market conditions which prevailed when the experiment was conducted.

SUMMARY.

The following statements are based upon the work of a single year and cannot be taken as absolutely final, yet the evidence from which these deductions are made is of a somewhat striking nature. It should be thoroughly understood, however, that further work is needed before final conclusions can safely be drawn.

The use of a ration containing 25 pounds of silage daily, per steer, was attended in this experiment with almost exactly the same rate of gain as was the use of a dry ration. (Page 156)

The results of this experiment indicate that silage may be used to good advantage in the fattening of cattle, when stover and hay are high in price. The relative value of the silage is not changed by market conditions, but its cash value would, of course, depend upon the prevailing prices for other feeds. (Page 157)

No difference in the finish of the two sets of cattle was apparent. This was shown by the fact that, although when the cattle were at market, one pen contained only silage-fed cattle, and another only dry-fed cattle, a buyer of wide experience, without knowing how the cattle had been fed, purchased both lots at the same price. Other expert cattlemen failed to note any difference between the two lots of cattle. (Page 160)

It is not to be expected that silage alone or silage and other rough feed will produce a high finish in a short feeding period, since not enough grain is present in the silage for this purpose. Less shelled corn was required, however, by the steers that received silage than by the ones that recieved only dry feed. (Page 156)

Hogs that followed silage-fed cattle, when less shelled corn was fed to the cattle on account of the corn in the silage, made fewer pounds gain per steer than did hogs that followed cattle receiving all of their corn in the form of shelled corn. (Page 157)

The feeding of tankage to the hogs that followed these cattle was attended with greatly increased gains. It is believed that other feeds, such as skim milk, linseed oilmeal, middlings, soy beans or alfalfa hay could be used to good advantage for this purpose. See Circular 73, of this Station, for results of feeding tankage to hogs in cattle feed lots. (Page 159)

High-priced feeds do not always prevent fair profits from being secured from feeding operations. Besides, the valuable by-product, manure, remains for use on the farm. The importance of using manure need not be emphasized here. Examples of farms upon which manure has been freely used and other farms from which practically all of the crops have been sold with the result that but little manure was produced and used, are abundant. The lesson is too evident to need any comment here. (Pages 161 and 164)

The experiment reported in this bulletin is being repeated in all essentials at present, and will be reported later. Final conclusions are reserved until further work is finished.